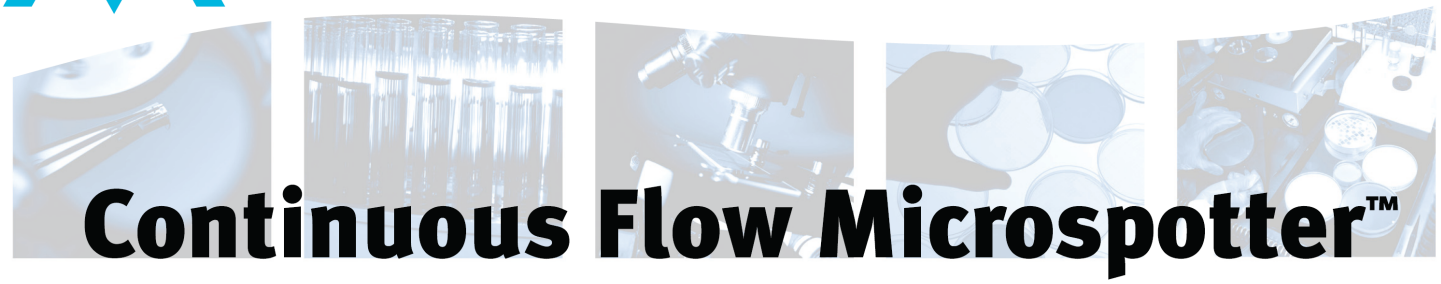
WASATCH MICROFLUIDICS
Innovative Biotechnology Solutions



Continuous Flow Microspotter™

Principle of Operation

The Continuous Flow Microspotter™ (CFM) uses flow to print microarray spots (Fig. 1). This allows more biomolecules to attach to the surface, thereby leveraging precious samples and allowing researchers to achieve dramatic increases in sensitivity. Initial results show an 86-fold improvement over standard droplet deposition technologies.

The CFM can be used to perform localized surface modifications, deposit biomolecules, screen heterogeneous samples for a biomolecule of interest, or perform multi-step analytical processes on a spot. The CFM's patent-pending design allows many samples to be printed in parallel from a standard microtiter plate, during which time each spot is kept isolated from surrounding spots and the atmosphere.

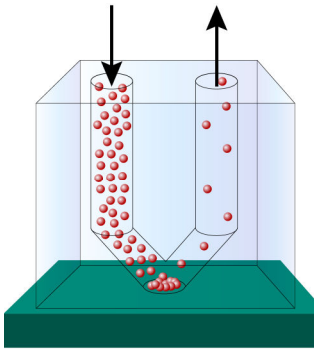


Fig. 1: Continuous flow formation of microspot

Competitive Advantages

- Enhanced surface concentration
- CVs of < 5% for standard concentrations
- Up to 86-fold improvement in sensitivity
- Improved spot uniformity and morphology
- Dead volume < 1 µL per microchannel circuit
- Solution recaptured, can be used for multiple printings
- Integration with microtiter plates
- Current cartridge prints 48 microspots simultaneously from a 96-well microtiter plate
- Scalable to 384-well microtiter plate
- Customizable spot dimensions and spacing

Product Development

Wasatch is developing a desktop instrument and consumable microfluidic printhead. A full commercial instrument is under development and will be available in late 2006. However, fully functional prototype instruments are currently available for collaborative testing and early purchase.

Fig. 2: Fully functional alpha prototypes with automated flow control

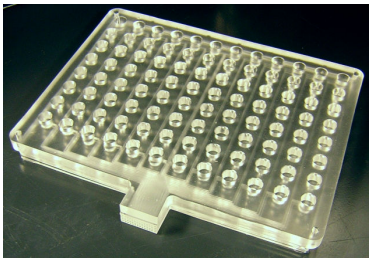


Fig. 3: 96-well CFM

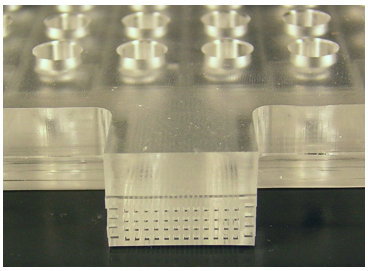


Fig. 4: Printing face

The 96-well device in Figures 3 and 4 is operated by pressing the printing face against a slide surface to form a seal. Vacuum and pressure are used to cycle small volumes of liquid through the microchannels and over the slide surface.

The 96-well device prints 48 spots simultaneously, each from a separate well. The spots are 400 microns square and form a two-dimensional 4 x 12 grid that is roughly 1 cm across by 0.5 cm high. Spot sizes and spacing can be customized for specific applications. A 384-well device will be developed in 2007, allowing 192 spots to be printed at once from a standard 384-well microtiter plate.

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APPLICATIONS OF THE CFM

- Array printing: Proteins, lipids, DNA, cells, carbohydrates, etc.
- Micro-ELISAs
- Assay development
- Biomarker research: Screening for low-concentration analytes
- High-throughput biosensing: Integration with a biosensor for high-throughput fluid delivery

PRELIMINARY RESULTS

Wasatch Microfluidics is validating the CFM in clinically relevant applications. Successful research is ongoing using cells, lipids, proteins, and Surface Plasmon Resonance (SPR) biosensing.

86-Fold Improvement in Sensitivity

Biotinylated protein A was deposited on a streptavidin/gold-coated SPR substrate. Adsorption density of the protein was measured by SPR and compared to a varying concentration curve generated with a Genetix QArray Mini pin spotter, shown below in Figure 5.

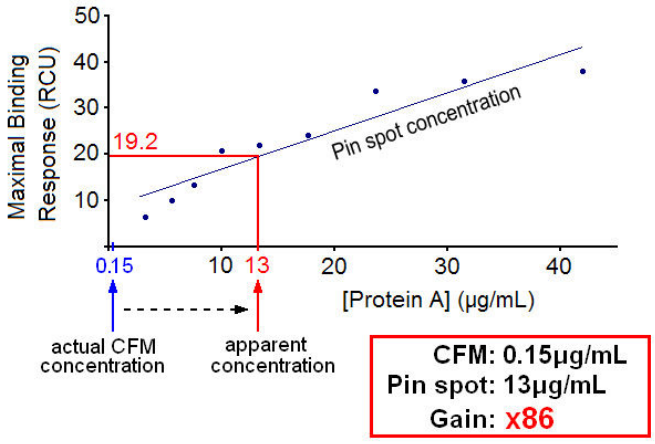

Fig. 5: Calibration curve showing a density increase of 86-fold with the CFM

The results in Figure 5 show that a 0.15 µg/mL solution cycled through the Continuous Flow Microspotter™ achieved the same results as 13 µg/mL pin-spotted solution, an **86-fold increase**! Therefore, the Continuous Flow Microspotter™ allows researchers more control over experimental results: lower concentration solutions could be used to obtain satisfactory results (cost and time savings on purification), or standard concentrations could be used to obtain significant increases in sensitivity.

Head to Head Testing: IgG Deposition

A sandwich assay was performed on anti-mouse IgG spots that were deposited with a pin printer and with the CFM (Figure 6). Clearly, the CFM performs better in two areas: 1) Dramatically superior sensitivity with dilute solutions – the pin 1 µg/mL spots are barely visible while the CFM spots exhibit significantly more binding; 2) higher quality, more uniform and discrete spots. It is significant that these results are from a first round of ongoing tests. Pin spotting can be difficult to optimize, but the forgiving flow deposition of the CFM technology enables a user to achieve phenomenal results in a short time frame.

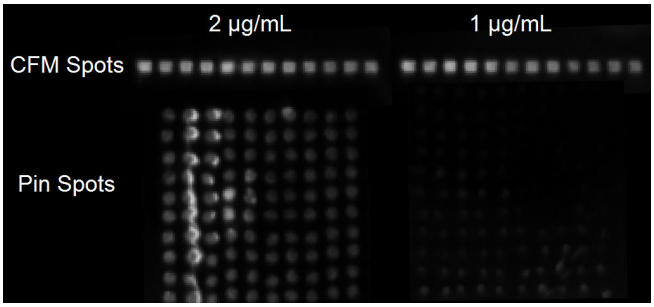

Fig. 6: Deposition of biotinylated IgG on a streptavidin slide at two concentrations using pins and the CFM.

Cell Studies

Ongoing research with Chinese Hamster Ovarian (CHO) cells shows that the CFM can be used to attach cells to a surface, deliver cell media and incubate for extended periods of time with high cell viability.

Lipid Studies

Lipid bilayer arrays are difficult to deposit. The lipids degrade when the spots dry and the hydrophobic solutions are difficult to deposit using traditional methods. The CFM is ideally suited for lipid arrays because the deposition process can be performed without exposure to air and the CFM doesn't rely upon variations in surface tension to control the transport and deposition of fluids. Initial research with lipids has produced viable lipid bilayer arrays which will serve a crucial role in the study of membrane proteins.

COLLABORATIVE TESTING

Wasatch is interested in providing early technology access to collaborative partners intent on multiplying the throughput of analytical processes and/or increasing the sensitivity and precision of their research. Please contact Josh Eckman, President, at (801) 581-6549 for more information.